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A NEW MEMBER OF THE GENUS *DISTOCAMBARUS* (DECAPODA: CAMBARIDAE) FROM THE SALUDA BASIN, SOUTH CAROLINA

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Abstract.—The burrowing crayfish *Distocambarus* (*Fitzcambarus*) *youngineri* is described from two localities in the southwestern part of Newberry County, South Carolina. In most respects it resembles the sympatric *D.* (*F.*) *carlsoni,* but the first pleopod of the male differs little from that of its more primitive congeners assigned to the nominate subgenus.

Within the Saluda River basin of South Carolina, a number of isolated colonies of crayfishes belonging to the genus *Distocambarus* have been found, and inasmuch as the ranges of the three species represented in them are sympatric, we are puzzled that we have not found them to be at least occasionally syntopic. The species described here appears to have established fewer populations than have *Distocambarus* (*D.*) *crockeri* Hobbs and Carlson (1983:421) and *D.* (*Fitzcambarus*) *carlsoni* Hobbs (1983:430), both of which also frequent the Savannah watershed. Despite our being unable to locate additional localities for it other than the two that have been discovered in the southwestern part of Newberry County, we believe that other colonies must exist elsewhere in the Saluda Basin.

Because of the combination of characteristics exhibited by this crayfish, to assign it to either of the subgenera that have been recognized requires an emendation of the existing diagnoses (Hobbs 1983:429, 430). The following are offered in support of our concept of the affinities of this crayfish that are discussed under "Relationships."

Subgenus *Distocambarus* Hobbs, 1981

Diagnosis.—Chela of male with mesial margin of palm distinctly longer than width of palm; carpus of cheliped weakly expanded distally; second pereiopod lacking conspicuous fringe of setae on merus; areola in animals with carapace length greater than 20 mm usually less than 15 times as long as wide; color although variable (brownish, greenish, or lavender) never with reddish or pinkish suffusion; female with annulus ventralis moving through arc of at least 50 degrees, and postannular sclerite conspicuously large, almost as long as annulus ventralis; burrows usually with only one or two openings to surface and consisting basically of single subvertical passageway and secondary short branch leading to surface.

Comprising two species: *Distocambarus* (*D.*) *crockeri* Hobbs and Carlson (1983: 421) and *D.* (*D.*) *devexus* (Hobbs, 1981:302).

Subgenus *Fitzcambarus* Hobbs, 1983

Diagnosis.—Chela of male with mesial margin of palm distinctly shorter than width of palm; carpus of cheliped expanded distally; second pereiopod with con-

spicuous fringe of setae extending distally from at least midlength of merus distally onto dactyl; areola in animals with carapace length greater than 19 mm seldom less than 15 times longer than wide; color variable (brownish, greenish, blue, or pinkish lavender) but usually pinkish lavender; female with annulus ventralis moving through arc of no more than 50 degrees, and postannular sclerite not conspicuously large, its length not greater than half that of annulus ventralis; except during droughts, burrows almost always with multiple openings to surface and usually with complex system of galleries.

Comprising two species: *Distocambarus* (*F.*) *carlsoni* Hobbs (1983:430) and *D.* (*F.*) *youngineri* (described herein).

Distocambarus (*Fitzcambarus*) *youngineri,* new species
Fig. 1

Diagnosis.—Body and eyes pigmented, latter small but well developed. Rostrum without marginal spines, tubercles, and median carina. Carapace with 1 to several small cervical tubercles. Areola 13 to 24 (average, 17.6) times as long as broad, and constituting 37.6 to 41.9 (average, 38.9) percent of entire length of carapace (41.9 to 46.6, average 44.6, percent of postorbital carapace length). Ventral surface of ischium of third maxilliped only partly obscured by plumose setae. First 3 pairs of pereiopods without conspicuous ventral brush of setae extending from basis to merus, although second pereiopod with distoventral half of merus and margins of more distal podomeres with fringe of long setae. First pair of pereiopods with ventral surface of merus densely tuberculate, corresponding surface of proximal part of both fingers lacking tubercles. First pleopods of first form male with small but distinct cephalic shoulder at base of conspicuous, corneous, subquadrangular, platelike caudodistally and somewhat mesially directed central projection; cephalic process vestigial at best, not clearly defined; mesial process broad basally, tapering distally in long pointed element directed caudodistally and slightly laterally. Mesial ramus of uropod with distomedian spine very small but almost or quite reaching margin of ramus. Female with anterior part of annulus ventralis membranous across which hingelike motion accomplished; postannular sclerite not half so long as annulus; first pleopods rudimentary, in form of small tuberculiform prominences.

Holotypic male, form I:—Cephalothorax (Fig. 1a, h) subovate, compressed laterally; maximum width of carapace greater than height at caudodorsal margin of cervical groove (12.1 and 10.4 mm). Abdomen distinctly narrower than thorax (9.0 and 12.1 mm). Areola 17.2 times as long as wide but with only 1 punctation in narrowest part. Cephalic section of carapace about 1.4 times as long as areola, latter comprising 41.9 percent of total length of carapace (45.8 percent of postorbital carapace length). Surface of carapace mostly punctate, few small tubercles in anteroventral branchiostegal region. Rostrum broader than long with margins tapering gently from base and slightly more sharply from base of poorly defined acumen to tip; latter reaching base of ultimate podomere of antennular peduncle; rostral margins not conspicuously thickened; upper surface distinctly concave and bearing, in addition to usual marginal punctations, few large, comparatively deep punctations. Subrostral ridge moderately well developed and evident in dorsal aspect to end of basal third of rostrum. Suborbital angle obtuse but distinct.

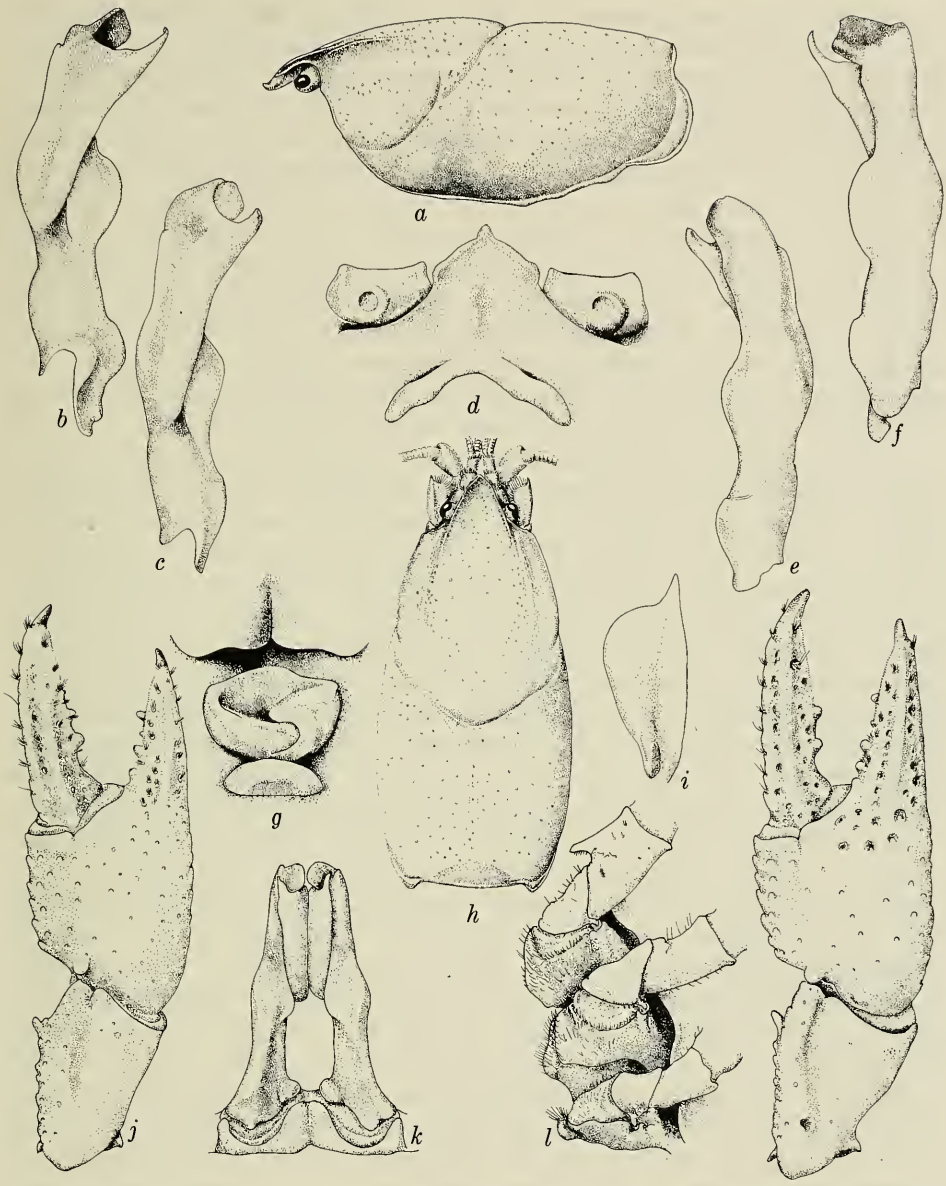

Fig. 1. *Distocambarus* (*F.*) *youngineri* (all from holotype except c, e from morphotype, and g, j from allotype): a, Lateral view of carapace; b, c, Mesial view of first pleopod; d, Epistome; e, f, Lateral view of first pleopod; g, Annulus ventralis and adjacent sternites; h, Dorsal view of carapace; i, Antennal scale; j, m, Dorsal view of distal podomeres of cheliped; k, Caudal view of first pleopods; l, Proximal podomeres of third, fourth, and fifth pereiopods.

Postorbital ridge clearly defined but merging insensibly with carapace anteriorly. Branchiostegal and cervical spines absent, latter represented by very small tubercle.

Abdomen shorter than carapace (21.5 and 24.6 mm). Pleura of second through

fifth abdominal segments rounded ventrally, lacking caudoventral angle. Cephalic section of scabrous telson with 1 strong, fixed spine in each caudolateral corner. Cephalic lobe of epistome (Fig. 1d) subtriangular with short anteromedian projection, margins slightly elevated ventrally; main body of epistome with shallow median depression but lacking distinct fovea; epistomal zygoma broadly arched. Ventral surface of proximal podomere of antennular peduncle lacking spine. Antennal peduncle with usual spine on ventral surface of basal podomere reduced to minute tubercle; flagellum reaching about midlength of areola. Antennal scale (Fig. 1i) 2.4 times as long as broad, widest distinctly distal to midlength; greatest width of lamellar area little more than 1.5 times that of thickened lateral part.

Third maxilliped overreaching antennal peduncle by length of ultimate podomere; mesial sector of ventral surface of ischium with clusters of stiff, long setae; lateral sector studded with clusters of shorter, plumose setae which also forming submarginal lateral row; merus with setae similarly disposed.

Right chela (Fig. 1m) subelliptical in section, strongly depressed; palm 1.4 times as broad as length of mesial margin; length of latter almost one-third that of entire length of chela; most of palm studded with squamous to subsquamous tubercles. Mesial margin of palm with row of 6 (5 on left) tubercles flanked dorsolaterally by row of 6 (4 on left). Both fingers with well defined dorsomedian ridges flanked by setiferous punctations. Opposable margin of fixed finger with row of 3 tubercles, second from base largest, along proximal two-fifths of finger and single row of minute denticles extending between and distal to tubercles from base to corneous tip of finger; prominent tubercle also present below row slightly beyond midlength of finger; lateral margin of finger costate with row of 5 deep, setiferous punctations. Opposable margin of dactyl with 2 large tubercles on proximal half beyond which single row of minute denticles extending to corneous tip of finger, and shallow, rounded excavation present along basal part of finger; mesial margin with 1 or 2 tubercles proximally, followed distally by row of setiferous punctations. Ventrolateral surface of chela with conspicuous longitudinal row of long setae which extending from bases of tubercles in proximal part of row and from ventrolateral punctations on finger.

Carpus of cheliped distinctly longer than mesial margin of palm of chela (7.3 and 4.5 mm) and bearing slightly sinuous dorsal furrow; dorsal surface of podomere sparsely punctate, mesial surface with upper longitudinal row of 5 small squamous tubercles and cluster of 8 larger ones below row, distalmost of cluster largest; mesial surface with few additional small tubercles, and ventrodistal margin with single large tubercle articulating with proximal ventrolateral condyle on propodus.

Merus with usual tubercles dorsally, distalmost larger than others; mesial face with few small scattered tubercles present on distal half; lateral surface sparsely punctate; ventral surface tuberculate: 11 tubercles in irregular lateral row and 12 in mesial row, other tubercles and plumose setae present between rows; tubercles in both rows increasing slightly in size distally, but none spiniform. Ischium with row of 4 tubercles ventromesially, otherwise punctate.

Hook on ischium of third pereiopod (Fig. 1l) simple, slightly flattened, but subacute, and barely overreaching basioischial articulation, not opposed by strong tubercle on basis. Ventral membrane of coxa of fifth pereiopod conspicuously

setose. Plumose pubescence associated with sternum and coxae of all pereiopods very prominent (not shown in illustration).

First pleopods (Fig. 1b, f, k) typical of genus in being symmetrical, not contiguous at base, reaching coxae of third pereiopods, bearing strong caudoproximal lobe and broadly rounded proximomedian lobe, flexed caudally slightly distal to midlength, and lacking subapical setae. Terminal elements described in "Diagnosis."

Uropods with only mesial lobe of proximal podomere bearing acute spine, that on lateral lobe rudimentary; mesial ramus with distomedian spine small and almost or quite reaching distal margin of ramus.

Allotypic female.—Differing from holotype, other than in secondary sexual features, in following respects: acumen of rostrum with base more clearly defined and reaching midlength of ultimate podomere of antennular peduncle; subrostral ridge evident in dorsal aspect to base of acumen; cephalic section of telson with 2 spines in each caudolateral corner, more mesial pair smaller and movable; median fovea present on epistome; flagellum of antennule reaching caudal margin of carapace; ischium of third maxilliped lacking tufts of plumose setae between lateral marginal row and mesial sector, latter bearing clusters of long stiff setae: mesial margin of palm of right chela (Fig. 1j) with row of 5 tubercles (6 on left) flanked dorsolaterally by row of 4; lateral margin of fixed finger with row of 7 setiferous punctations; opposable margin of dactyl with row of 3 tubercles (left with 4), distalmost smallest; mesial surface of carpus with 5 small tubercles interspersed among 5 larger ones; small tubercle present on ventrodistal margin of carpus opposite ventral condyle on proximal margin of propodus. (See "Measurements.")

Segment of sternum between fourth pereiopods with very narrow median fissure (expanding anteriorly) extending entire length.

Annulus ventralis (Fig. 1g) hinged between caudal sclerotized part and semimembranous anterior region (moving through arc of some 30 to 45 degrees), approximately 1.4 times as broad as long; anterior section broadly excavate; tongue descending into centrally located fossa from high sinistral wall; sinus originating in fossa near median line, extending sinistrally and making almost U-turn from which extending caudodextrally to median line where ending on caudal face of annulus.

Postannular sclerite almost three-fourths as wide as annulus ventralis, but distinctly less than half as long; central area elevated (ventrally) with anterior face convex and posterior surface flattened.

Morphotypic male, form II.—Except in secondary sexual characters, differing in no conspicuous way from holotype, few differences noted, probably reflecting juvenile condition of specimen: subrostral ridges evident in dorsal aspect from orbit almost to base of acumen; cephalic lobe of epistome lacking anteromedian projection; flagellum of antenna almost reaching caudal margin of carapace; fixed finger of chela with only 2 tubercles in row on proximal opposable margin, and other tubercles on chela not arranged precisely as in holotype, but possessing same numbers on either right or left members; ventral surface of merus of cheliped with lateral row of 8 tubercles and mesial row of 10.

Hook on ischium of third pereiopod tuberculiform, not projecting nearly so far

proximally as that in holotype, and plumose setae on sternum and coxae of pereiopods much shorter, not obscuring distal part of first pleopods; latter (Fig. 1c, e) with oblique juvenile suture in proximal half of appendage, shoulder on cephalic surface situated slightly more proximally than in holotype; both terminal elements heavier and less attenuate, non-corneous central projection not nearly so lamelliform, and not even rudiment of cephalic process discernible.

Color notes.—Holotypic male with carapace mostly pale bluish lavender fading ventrally to pinkish cream; antennal, mandibular, and most of hepatic and anteroventral branchiostegal areas also pinkish cream. Caudodorsal ridge almost white. First through fifth abdominal terga brownish red suffused with lavender, fading caudally; tergum of sixth segment, telson, and uropods translucent, that of sixth segment with faint pink tint. Pleura translucent with pinkish cream blush. Dorsum of cheliped bluish lavender from midlength of merus distally, color intensified at distal end of merus and carpus and along mesial margin of palm and proximomesial part of dactyl; ventrolateral part of propodus and ventral and ventrolateral parts of all podomeres pinkish cream. Remaining pereiopods pinkish cream with lavender suffusion, latter intensified on distal half of merus and on proximal half of carpus. Eyestalks, antennules and antennae uniformly pale bluish lavender; third maxilliped and ventral part of body pinkish cream.

Paratypic male, form I, with carapace distinctly reddish tan, fading to pink laterally, dorsolateral parts of rostrum and posterior flank of cervical groove darker than elsewhere. Abdomen as in holotype except tergum of sixth segment and marginal areas of pleura, uropods, and telson pale pinkish orange. Antennules and antennae reddish, only little paler than carapace, dorsodistal parts of podomeres of peduncles darker than elsewhere. Chelipeds pinkish orange with brownish triangular mark on dorsodistal part of merus, similarly colored marks flanking groove on dorsal surface of carpus becoming very dark where merging distally. Chela with dorsal dark band across distal part of palm (ridge at base of dactyl almost black) and proximodorsal parts of both fingers dark, becoming lighter toward ends; dactyl darker than propodus; tubercles on mesial part of palm very dark. Ventral surface of chela deep pink. Other pereiopods pinkish orange with dark suffusion on distal part of merus and carpus, distal margin of merus especially dark. Third maxilliped and venter pinkish to purplish cream.

Females almost concolorous: lavender to lavender pink with dark markings on dorsum of chelipeds from merus distally.

	Measurements (mm)		
	Holotype	Allotype	Morphotype
Carapace			
Height	10.4	12.2	8.5
Width	12.1	15.0	9.7
Entire length	24.6	30.6	20.1
Postorbital length	22.5	26.9	17.6
Areola			
Width	0.6	0.9	0.5
Length	10.3	12.2	8.0
Rostrum			
Width	4.7	5.2	3.4
Length	4.3	5.0	3.0

Chela			
Length of mesial margin of palm	4.5	5.5	2.8
Width of palm	6.2	7.4	4.0
Length of lateral margin	13.2	16.5	8.7
Length of dactyl	8.5	10.1	4.5
Carpus of cheliped			
Width	4.3	5.4	3.1
Length	7.3	9.0	5.0
Abdomen			
Width	9.0	11.1	7.2
Length	21.5	25.0	15.8

Types.—The holotypic male, form I, allotypic female, and morphotypic male, form II (numbers 208413, 208414, and 208415, respectively) are deposited in the National Museum of Natural History, Smithsonian Institution, as are the following paratypes: 4 ♂I, 2 ♂II, 17 ♀, 9j ♂, 14j ♀, 3 ♀ with young.

Type-locality.—Burrows in area adjacent to small woodland pool, about 50 m southwest of State Route 58 on Route 22 (11 airmiles due west of Newberry, Newberry County, South Carolina) (34°18′N, 81°48′W). There in a wooded area supporting a dense growth of *Pinus, Quercus,* and *Nyssa,* the chimneys constructed by members of *Distocambarus* (*F.*) *youngineri* mark the complex systems of galleries that have been excavated in the sandy clay soil.

Range.—Even though intensive searches have been made to discover other colonies of this crayfish, until now it has been found in only one locality other than that cited above: roadside ditch on State Highway 121, 0.15 mile northeast of its junction with State Highway 34, just east of Silverstreet, and only nine airmiles from the type-locality.

Specimens examined.—Thirty-one specimens have been collected from the type-locality as follows, 3 ♀, 1j ♂, 2j ♀, 17 Dec 1982, PHC, collector; 2 ♂I, 7 ♀, 2j ♂, 3j ♀, 2 ♀ with yng, 6 Mar 1983, PHC; 3 ♀, 1j ♀, 22 Jun 1983, PHC; 2 ♀, 3j ♂, 29 Oct 1983, PHC, GBH, HHH. From the other locality just east of Silverstreet, the following are available: 1 ♂II, 1J ♀, 11 Nov 1983, PHC; 3 ♂I, 1 ♂II, 3 ♀, 3j ♂, 7j ♀, 1 ♀ with yng, 18 Feb 1984, PHC.

Variations.—Most of the variations noted in this crayfish are indeed minor ones. The ratio of the length of the carapace to that of the areola in specimens from the type-locality ranges from 37.1 to 40.5 (average 38.9) whereas that in the other locality is 37.8 to 40.8 (average 39.1), the range of the corresponding ratios of the areola length to postorbital carapace length 42.2 to 46.1 (average 44.4), and 41.9 to 46.4 (average 45.1), and that of the corresponding ratios of the length to the width of the areola 13.0 to 24.0 (average 18.1) and 10.0 to 18.0 (average 16.4 mm), thus even though the areolae of specimens from the type-locality are slightly shorter and narrower than that found in the other locality, specimens from the two places cannot be separated with certainty. The rostrum exhibits perhaps the most conspicuous variations: it ranges from subtriangular to broadly subovate, and the acumen may or may not be rather clearly delimited basally; in all specimens it is somewhat deflected ventrally, and in one very strongly so; the apex of the acumen may not reach the base of the penultimate podomere of the antennular peduncle, or it may overreach it. The mesial surface of the chela bears

a row of 5 to 7 tubercles, and the row immediately dorsolateral to it consists of 4 to 6. The opposable margin of the fixed finger bears a row of 2 to 4 tubercles in addition to the more distoventrally situated tubercle, and the dactyl also exhibits a row of 2 to 4 of them.

Size.—The largest specimen available is a female, which has a carapace length of 31.7 (postorbital carapace length 27.4) mm. The corresponding length of the smallest and largest first form males available are 12.1 (10.4) mm and 29.2 (25.6) mm. The smallest female carrying young (no ovigerous females have been found) has corresponding lengths of 27.1 (23.4) mm.

Life history notes.—Two first form males, each found in a burrow with a female, were collected on 6 March 1983, and three were obtained on 18 February 1984 when some of the females taken were observed to bear sperm plugs in their annuli ventrales. A first form male and a female with carapace lengths of 26.5 and 29.4 mm, respectively, were found together in a burrow on 18 February 1984. Young with carapace lengths of 6.8 to 11.8 mm were obtained from the burrow of a female on 18 February 1984, and others with corresponding lengths of 7.9 to 11.0 with two females on 6 March 1983.

Ecological notes.—*Distocambarus* (*F.*) *youngineri* is a primary burrower, and its abode is generally marked by three or four openings, one or more being sealed by a capped turret. Irregular horizontal galleries, 30–60 mm beneath the soil surface connect the openings, and one or two vertical to subvertical shafts penetrate the groundwater, reaching a maximum depth of about 60 to 70 cm below the soil surface.

One of the burrows excavated in December, 1982, and all of those dissected in June and October, 1983, were much less complex than others investigated in December, 1982, and in March, 1983. These simple burrows consisted of only one subvertical shaft which led beneath the surface of the groundwater. During drought conditions the sandy-clay soil became so hard that excavating an entire burrow would have been exceedingly difficult, but there was evidence that some of the upper galleries had been filled with soil that presumably had been removed from the wet fundus of the main vertical shaft. As a result, the burrows seemed to be comparatively simple during these periods.

On March 6, 1983, one pair was found in a horizontal passageway, only 30 to 40 mm beneath the soil surface. Most other specimens were encountered deep under the water in the somewhat enlarged chambers at the bases of the subvertical passages. Juveniles appear to have constructed simple burrows emanating from that occupied by the mother.

The only features that appear to distinguish most burrows occupied by first form males from those of females are their proximity to the more permanent surface water and, except for those complex burrows in which a female is also present (presumably the male is the temporary occupant), they are comparatively simple. The small woodland pool at the type-locality was carefully sampled on two occasions, and on neither was a crayfish found in it. Moreover, no openings to flooded tunnels could be located.

No other crayfishes were found in the immediate areas occupied by *D.* (*F.*) *youngineri.*

Relationships.—This crayfish has its closest affinities with *Distocambarus* (*F.*) *carlsoni,* sharing with it, among other features a rostrum that is shorter than wide, a comparatively narrow areola, a reduced abdomen, a cheliped in which the mesial

margin of the palm of the chela of the male is shorter than the maximum width of the podomere and shorter than the carpus, stocky first pleopods in which the central projection is more strongly recurved than in the other two members of the nominate subgenus, an annulus ventralis that is movable through an arc of no more than 50 degrees, and a wedgelike postannular sclerite that is not conspicuous and not nearly so long as the annulus. It differs from *D.* (*F.*) *carlsoni* most conspicuously in the secondary sexual features of the male and in the more strongly tuberculate ventral surface of the merus of the cheliped. The shorter, broader, subquadrangular shape of the central projection of the first pleopod of the first form male is strikingly different from the elongate bladelike element in *D.* (*F.*) *carlsoni,* as is the mesial process which projects caudodistally rather than caudally. In the female, the cephalic region of the annulus ventralis is broadly and comparatively deeply excavate whereas in the typical form of *D.* (*F.*) *carlsoni* it is seldom more than narrowly, and usually quite shallowly excavate.

Had this crayfish not been discovered there would be less evidence for our conclusion that *D.* (*F.*) *carlsoni* should be considered a congener of *D.* (*D.*) *crockeri* and *D.* (*D.*) *devexus* (Hobbs 1981:302). Possessing a first pleopod in the male that markedly resembles that of the last two mentioned species, but having a body and chelipeds that are clearly more like those of *D.* (*F.*) *carlsoni, D.* (*F.*) *youngineri* seems to tie the latter even more firmly to these two species. Moreover, the discovery that sperm plugs occur in the annuli ventrales of *D. carlsoni* and *D. youngineri,* a feature that to our knowledge has never been observed in a member of the genus *Cambarus,* lends greater assurance that *D. carlsoni* is not, as the first pleopods of the male suggest, a product of the cambaroid line of evolution. With little imagination one might visualize *D. youngineri* as an arrested state in the evolution of *D. carlsoni* from a more primitive *D. crockeri*-like ancestor.

Etymology.—This crayfish is named in honor of our mutual friend, Edward M. Younginer of the Department of Health and Environmental Control, Columbia, South Carolina, who not only has offered us encouragement throughout the course of our study of the crayfishes of South Carolina, but also has assisted us in obtaining many of the collections that are now available.

Acknowledgments

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